

- Pelseneer, P. 1935. Essai d'Ethologie Zoologique d'apres L'etude dos Mollusques. Acad. Roy. de Belgique. Classe des Sciences. Fondation Agathon de Potter., No. 1. 662 pp.
- Sullivan, C. M. 1948. Bull. Fish. Res. Bd. Canad. 77: 1-36.
- Whedon, W. F. 1936. Univ. Calif. Publ. Zool. 41: 35-44.
- Wiborg, K. F. 1946. Undersokelser over obskjellet (*Modiola modiolus*). Fisk. Direct. Skrif. 8: 1-85.
- Young, R. T. 1942. Ecol. 23: 490-492.
- 1946. Ecol. 27: 354-363.

PUERTO RICAN LAND OPERCULATES

By H. BURRINGTON BAKER

The symbols for Puerto Rican localities have been explained recently (1961).

Alcadia (Striatemoda) striata (Lamarck) and form *subfusca* (Menke). Typical form (with thickened peristome) infrequent; shells usually yellowish unicolor (En1, Er3, Es4, Jn1, Pr1-3, Wr3) but also bicolor fulvous, with light sutural and (weaker) peripheral bands and basal spot (Pr6, Ps2, Wn, Wr3; and Ws, but paler); good climber, up to 10 ft.; males and females subequal in size. Paedogenetoid (with "immature" shell but often sexually mature) form *subfusca* common, almost everywhere. (Ee, Es, Jn, Js, Pn, Pr, Ps, Wn, Wr, Ws); climbing but also under leaves on ground, 0-4000 ft. Animal dark above, bluish black on dorsum of head and tentacles; tail lighter, attenuate; sole weakly tripartite; secretes copious mucus.

Alcadia (Hjalmarsona) hjalmarsoni (Pfeiffer). Terrestrial; Pr3, 4, 6, Wr; western highlands, 1800-3400 ft.; males and females subequal in size; shell uniformly yellowish, tinged with fulvous, which becomes stronger near peristome. Animal greenish, with dark olive blotches and darker tentacles; sole weakly tripartite.

Alcadia (Schrammia) alta (Sowerby). Subarboreal, aestivating in dead *Cecropia* leaves, caught in vines, etc., 4-10 ft. above ground; Es, Jn, Pn, Pr; 100-4000 ft.; absent from wettest (Er) and driest places; males commonly smaller and higher but intergrading widely with females; yellowish and fulvous forms subequal in numbers, but some lots all fulvous. Foot with some grayish blotches on sides; sole as in preceding.

Helicina (s. s.) phasianella "Sowerby" Pfeiffer. Rare, but good climber up trees on dampish lowlands (En, Jn, Ws; 0-400 ft.) but commoner and subarboreal (often roosting in folded pinnae of palms) at western (driest) end of Cordillera Central (Wr3, around 3000 ft.); males and females subequal in size. Shell color

ranging from light unicolor (only Wr3) with trace of chalky white, peripheral band (most constant feature) through very variable patterns of spiral bands and/or flammulations, to almost solid fulvous (1 shell). Animal with attenuate, leaf-like tail.

Lucidella (Poenia) umbonata (Shuttleworth). Weak climber on driest limestone rocks, Ps, Wn, Ws and Mona Island (Clench, 1951); fulvous color form commoner than yellowish; no data on sexes yet.

L. (Poeniella) plicatula vinosa (Shuttleworth, 1854: 92). Terrestrial, En, Jn, Pn, Pr, Wr, Wn, Ws, Ww, 0-4000 ft.; apparently absent from wettest (Er) and driest (Ps) places; fulvous (*vinosa*) color form commoner than yellowish; no data on sexes. Shell smaller (down to maj. diam. 3 mm.) than typical *plicatula*, especially in lowlands (near San Juan, Js1, now selected as type locality) but attaining maj. diam. 4.1 mm. with $4\frac{3}{4}$ whorls in highlands (Pr), rounded to subangulate, with rounded or flattish growth riblets, separated by interspaces (varying in same lot) from 1 to over 2 times their width above periphery of last whorl (more widely spaced below); umbilical callus varying (apparently with age) from depressed and punctulate (Cf. van der Schalie, pl. 1, figs. 5) to convex and almost smooth; with basal peristome varying similarly from slenderly sinuous (figs. cited) through (commonly) strongly swollen to (weakly and rarely) subdentate; fresh ones with sharp, submicroscopic, spiral striae, most evident in interspaces but weakly surmounting growth riblets.

Obviously, this small species is transported adventitiously and, because of variation in these lots, the following (at least) are considered conspecific, although larger series may prove them also to be island subspecies:

Vieques: ANSP. 14836, *vinosa* (Riise!). St. Kitts, Leeward Is.: ANSP. 62062, type lot of "var." *christophori* (Pilsbry, 1897 (3): 118, but used by me, 1923, as species or subspecies): sizeable series of youngish (depressed umbilical callus) but mature, fresh whells varying from size of *plicatula* (maj. diam. 5 mm., with $1\frac{1}{2}$ whorls and even more "subdentate" than Pfeiffer's, Conch. Cab., pl. 8, figs. 39-42; not 36-39) to (rarely) size and form of *vinosa*. Guadeloupe: 2 small lots; ANSP. 14798 (Grasset!) about size of *plicatula* (so labeled) but not markedly subdentate; ANSP. 14785 (Marie!) whitish whells size of *vinosa* (labeled *euglypta*). Martinique: no shells seen, but type locality of *Helicina plicatula* Pfeiffer, 1849, and of *H. euglypta* Crosse, 1874 (influenced by Franco-Prussian war?). St. Lucia: *L. denseplicata*

A. J. Wagner, 1910, *Conch. Cab.*: 348, pl. 69, figs. 14 & 15. St. Vincent: "*H. rugosa* Pfr." E. A. Smith, 1895, *Proc. Malac. Soc. London* 1: 311, with *vinosa* and *ignicoma* as synonyms? Trinidad: *H. ignicoma* Guppy, 1868, apparently founded on youngish shells, but maj. diam. 4.5 mm. Barbados: ANSP. 14783, labeled "*H. conoidea* Pfr., var." by Bland. Santo Domingo, northeast coast: *L. (P.) samana* Pilsbry, 1928 (24): 481, pl. 27, figs. 6 & 7; type shell with only traces of spirals because obviously subfossil and apparently with calc. deposit. Gonave I., Haiti: *L. (P.) gonavensis* Pilsbry, loc. cit., figs. 8 & 9; type shell bleached.

L. (P.) barbadensis (Pfeiffer, 1854) from Barbados. Distinct species, but probably a *Poeniella*, with mainly much finer but more irregular, growth threads. Includes ANSP. 14916 from Bland (labeled *barbadensis*); 85468 (L. B. Brown, 1903!); 14926 from Swift (labeled *H. conoidea* Pfr.?); briefly keeled and decidedly angulate to higher shells which are less angular; varying from 3.1 to 5.7 mm. in diam.; approaching *H. conoidea* Pfr., 1854, and *L. holoserica* A. J. W., 1910: 350, pl. 69, figs. 16-19, but at least slightly angulate, often lighter at periphery but never with as sharp a peripheral band as in Wagner's figs. (but not mentioned in his description); both fulvous and yellowish forms. (*H. grenadensis* Smith, 1895: 318, pl. 21, figs. 16-18, from Grenada, seems similar to *conoidea*.)

Fadyenia (s. s.) *portoricensis* (Pfeiffer). On and under rocks and superficially on dead leaves; Pn2, Wn, Wr2, 3; 0-3000 ft.; both yellowish and fulvous color forms present. Sole tripartite, with 1 or 2 coarse waves on middle area.

Typical *Fadyenia* probably is carried adventitiously; it also occurs in Venezuela. In fact, *F. portoricensis* is quite similar to the variable *F. lindsleyana* (C. B. Adams), and possibly some of Chitty's obsolete Jamaican "species" may prove to be synonyms of it.

Ceratodiscus portoricanus Pilsbry & Vanatta. Quite deep in leaf humus; Pn, Pr3, 5, Wr, 100-3000 ft. west of San Juan; yellowish form commoner than fulvous. Shell (held upright like in planorbids) with two, serrate, spiral flanges of attached mud (like in *Fadyenia*); sole more weakly tripartite than in *Fadyenia*, but with similar locomotion.

Stoastomops (s. s.) *puertoricana* H. B. Baker. Only known from type locality (Ps2) and Mona Island (Clench, 1951) but easily missed because of excellent camouflage; however special searches were made for it on the northern limestone, especially where *Pseudopineria*, which also covers itself with limestone dust, was collected; color forms and habitats discussed when

described (1941c: 1). Foot whitish. Other two known species from Jamaica and Curacao.

S. (Swiftella) boriquireni H. B. Baker. Only known from type locality (Ws) and discussed when described (1941c: 2).

Megalomastoma (s. s.) *verruculosum* (Shuttleworth). Er3, empty shells frequent in one small area, about 2000 ft. elevation; see notes quoted by van der Schalie (1948: 30). The one male animal has a short foot and salmon-pink tentacles.

M. (Nesopupina) croceum (Gmelin). Burrowing; En, Es2, Jn, Pn, Wn; males averaging smaller but extensively intergrading in size with females; no differences in the animal from that of *hjalmarsoni* were noted.

M. (N.) croceum hjalmarsoni Pfeiffer. In dirt; Pr, Wr, 2000-4000 ft. in Cordillera Central; relative differences between sexes much as in *croceum*. Animal with whitish triangle on back of head; foot darker on sides and sole slate color; apparently sluggish (or timid) since my notes despairingly state: "None move."

Most of my lots of the highland and lowland forms could be separated on size alone, if sex differences be taken into consideration, although those from Pr6 and Wr2 are intermediate in size. Like most burrowing snails, the shells of living adults of typical *croceum* are devoid of epidermis, and even of patches of ostracum, so that they look like "bones." No examples of this species were seen above 1500 ft. elevation in the Luquillo Mts. All examples of *hjalmarsoni* from Pr1 (4000 ft. elevation) and Wr3 (3000 ft.) and one shell from Wr2 retain the brownish to chestnut-olive epidermis, and traces are visible on some of the others (See 1943b: 106-107).

Crocidopoma (Amphicyclotulus) portoricense (O. Boettger). Not collected; although a few hours were spent above 1500 ft. on Rio Blanco (Er5), I was unaware of its description; it may be very local (like *M. verruculosum*) or extinct (most of the slopes below looked like grasslands).

Licina (Choanopomops) decussata (Lamarck) and approaching *senticosa* (Shuttleworth); type locality for latter, now selected, Vieques Island. Good climber on trees, off limestone (Ee; all *decussata*; 80% males out of 15 of which sex known); on limestone (En; intergrading with *senticosa*, van der Schalie's pl. 2, fig. 3; 59% males out of 92); on limestone cliffs (Jn2; 2 males, both nearer *senticosa*). Males considerably smaller but intergrading in size with females, as usual in American pomatiids.

L. (C.) *DECUSSATA* YAUCOI, new subspecies.

Figs. 1

Shell similar to *senticosa* but ground color lighter, with

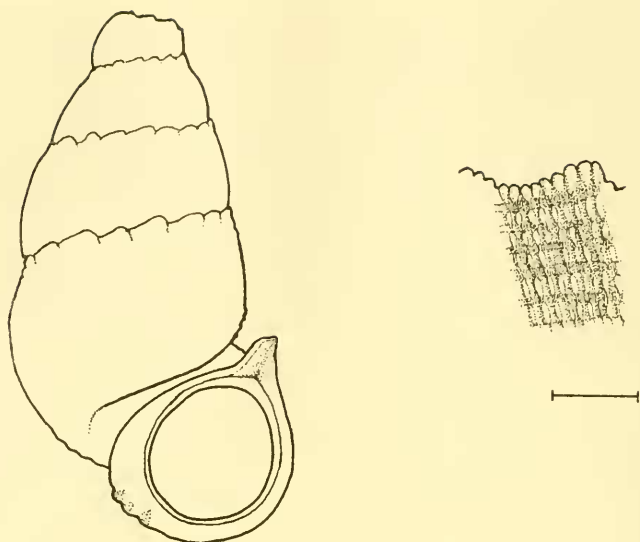


Fig. 1. *Licina decussata yaucoi* H. B. Baker. Type shell on left; detail of subsutural sculpture (scale = 1 mm.) at right.

stronger and more distantly spaced (7-8 per mm. on last whorl) growth riblets, which are broken almost completely by the spirals into elongate nodules; sutural crests almost confluent and becoming gradually higher in series of 9 to 11, so as to render suture serrate (rather than crenulate as in *senticosa*); peristome markedly duplex; outer one with high crest over parietal angle and broader on columellar side (often weakly crenulate). Type (female) shell: length 16.3 mm., maj. diam. 53 (8.7 mm.), minor diam. 45 (7.3 mm.); peristome (outside) 39 (6.3 mm.) by 57 (3.6 mm.); aperture (inside) 28 (3.0 mm.) by 83 (2.5 mm.) with 4 whorls remaining. ANSP. 256031. Type locality: east of Tallaboa (Ps1); 2 males and 3 females.

L. (C.) decussata yaucoi, var. a. Ps2: 1 male and 3 females. Ps3: on trees, 2-8 ft. up, during rain; 56% males out of 16; seen copulating. Riblets similarly spaced to *yaucoi* but much less broken into nodules by spirals; peristome less expanded and less crested (thus approaching *senticosa*).

L. (Chondropomops) aguadillensis (Pfeiffer). Weakly climbing on limestone rocks after rain, Wn; males 54% out of 156, but many accidentally mixed are excluded and these seem mainly males. Shells like van der Schalie's pl. 2, fig. 4, which resembles an old male, but commonly with less protruded inner peristome and often with lower crest above parietal angle; growth riblets finer and weaker than in *turnerae* and with their sutural crests

completely fused into clumps of 2 or more; outer peristome reflexed almost into plane of aperture.

L. (C.) aguadillensis turnerae (Clench), the "roughly sculptured" variety of 1941c: 3. Near Cerro Capron (Ps2) under and on top of limestone rocks; 62% males out of 42. Shells like Clench's, 1951, fig. 1, excellent photograph of (youngish female of?) this subspecies (from Mona I.) but, when fully developed, with more duplex peristome and higher parietal crests (but all less so than in typical *aguadillensis*, and with outer peristome more expanded than reflexed) and with sutural crests of riblets more accentuated (but separated), usually in pairs at irregular intervals.

L. (C.) aguadillensis turnerae, var. a. Ws; no data on habits, but 68% males out of 37. Somewhat intermediate between *turnerae* and typical *aguadillensis*, but closer to the former; accentuated, paired, sutural crests of riblets joined proximally but distinct at their edges.

The above 3 varieties are considered conspecific, but probably the late Dr. Bartsch would have described them as separate species, and I cannot prove their intergradation, perhaps because no collections were made at interposed localities. The operculum is as usually in *Choanopomops*, i.e., with the calcareous plate incomplete and much closer to the horny one than in *Choanopoma*, although often roughly parallel to it, as in the southern *Tudora* or in Jamaican *Colobostylus*. Dr. van der Schalie's figure of *senticosa* (cited above) also shows the calcareous plate of the operculum clearly, and its black border probably represents the protruding horny plate.

L. (C.) graminosa H. B. Baker. Terrestrial habits discussed in description (1941c: 3); apparently prefers deeper and rottener soil; Ps1 & 2.

Chondropoma (Chondropomorus) blauneri (Shuttleworth). Only found at what is now selected as the type locality, La Valvera, near Humacao (Es3). Apparently good climber on trees and not searched for under rocks, but, when animals were examined (months later) every living adult was a male.

These data seem to indicate that, at least during excessively dry weather, the males are more persistent climbers! As already indicated, the opercula of these Puerto Rican species approach those of the subgenus *Cistula* (+ *Parachondria* Dall); Cf. van der Schalie, pl. 2, fig. 4.

Chondropoma (Chondropomorus) yunquei H. B. Baker. Only known from type locality (Er2); habits and sizes discussed in description (1941c: 4); 71% males out of 24. Evidently closest to *C.*

conseptum (Martens), as figured by van der Schalie, 1948: pl. 2, fig. 8, from Aguas Buenas, and collections from the intervening 22 miles might show that intermediates exist.

Chondropoma (*Chondropomorus*) *riisei* (Pfeiffer). Good climber up to 10 ft. on trees; unlike two preceding species, only found by me on or near limestone; Jn, Wn (67% males out of 27). Described as a *Cistula*.

C. riisei newtoni (Shuttleworth). Abundant; good climber up to 10 ft. on trees and also on rocks; limestone canyon of Rio Grande de Arecibo; Pn1 (now selected as exact type locality; 57% males out of 122) and Pn2. Sides of foot pale greenish, shading into light chrome near sole; tentacles light but eyes black; "muzzle" streaked and spotted with dark olive; sole bipartite (as usual in pomatiids).

C. terebra Pfeiffer, 1861, appears to be a junior synonym, and his "Sierra Morales" about 10 miles southeast of this locality; from van der Schalie's (1948: 34) map for *C. riisei*, the latter may have collected there. About the only excuse for the retention of *newtoni*, even as a local race, is that it has a name.

Chondropoma (*s. s.*) *schaliei* H. B. Baker. Also on top of rocks, copulating; Pn1, 2; general habits given in description (1950: 18). Body slightly pinkish, with salmon tentacles.

Of the 149 samples of known sex in the type lot (Ps2) 63% are males. Statistically tested, this difference in numbers between the two sexes is very significant but, when correlated with the data on *C. blauneri*, it may indicate only that one can fail to make a random sample, even in a small area. At least, the preponderance of males obtained in all the largest lots of pomatiids, accentuates the need for great care in collection of samples, if ones wishes to use statistical methods in systematics.

Years ago, a lengthy mathematic study (unpublished) was made of a large series of *Allogona townsendiana minor* (or *ptychophora*), and the combined total gave a very platycurtic "curve," which was significantly bimodal largely because I had picked up every example of the rarer, but bigger and prettier, ecologic form *lombardi* (+ *castanea*). Incidentally, *lombardi* failed to intergrade in size with the typical form in one small area in the Bitter Root Mts., where their habitats were sharply demarcated, but both forms intergraded when their biotic conditions also did.

REFERENCES: Listed in 1961, Naut. 74: 142-149, to 75: 145.